

CHAPTER 5

EXTENDED DETENTION PONDS

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DEFINITION

An extended detention pond is a detention structure that is designed to temporarily hold storm water for up to 24 hours. The extended detention pond is normally dry between storm events, but may have a shallow marsh in the detention area. Unlike dry detention ponds, which only detain runoff long enough to reduce the peak rate of runoff, extended detention ponds detain stormwater runoff for a longer period of time to allow for settling of particulates.

EFFECTIVENESS

The United States Environmental Protection Agency (1993) lists the following percent removals for extended detention ponds:

Pollutant	TSS	TP	TN	COD	Pb	Zn	Factors
Average	45	25	30	20	50	20	Storage volume
Reported Range	5 - 90	10 - 55	20 - 60	0 - 40	25 - 65	(-40) - 65	Pond shape
Probable Range	70 - 90	10 - 60	20 - 60	30 - 40	20 - 60	40 - 60	Detention time
No. Values	6	6	4	5	4	5	

Schueler (1987) gives the following regarding the effectiveness of extended detention ponds:

Extending the detention time of dry or wet ponds is an effective, low cost means of removing particulate pollutants and controlling increases in downstream bank erosion. If stormwater is detained for 24 hours or more, as much as 90% removal of particulate pollutants is possible. However, extended detention only slightly reduces levels of soluble phosphorus and nitrogen found in urban runoff. Removal of these pollutants can be enhanced if the normally inundated area of the pond is managed as a shallow marsh or permanent pool.

Extended detention ponds significantly reduce the frequency of occurrence of erosive floods downstream, depending on the quantity of stormwater detained and the time over which it is released. Extended detention is extremely cost-effective, with construction costs seldom more

than 10% above those reported for conventional dry ponds.

Pollutant Removal

Settling is the primary pollutant removal mechanism associated with extended detention. As such, the degree of removal is dependent on whether a given pollutant is in particulate or soluble form. Removal is likely to be quite high if a pollutant is particulate, whereas very limited removal can be expected for soluble pollutants. Unfortunately, some urban pollutants of greatest concern occur primarily in soluble form (e.g., nitrate and ortho-phosphorus). Removal of these soluble pollutants may be obtained if the lower stage of the extended detention pond is managed as a shallow wetland to utilize natural biological removal processes.

Additional Removal by Biological Means

Biological removal of soluble pollutants can be achieved by creating artificial wetlands in the lower stage of a dry extended detention pond. Marsh plants, algae and bacteria that grow on the plants and shallow, organic rich sediments can take up soluble forms of nutrients needed for their growth. Also, the marsh sediments are an excellent substrate for pollutant sorption.

PLANNING CONSIDERATIONS

Extended detention ponds are useful for developments that are not large enough to support a wet pond or created wetland. Wet ponds and created wetlands are preferred over extended detention ponds due to their higher removal efficiencies, particularly of soluble pollutants.

Extended detention ponds are typically composed of two stages: an upper stage that stays dry except for larger storms, and a lower stage designed for typical storms. Ponds can be provided with plunge pools at the inlet, a micropool at the outlet, and an adjustable reverse slope pipe as the outlet control device. The United States Environmental Protection Agency (1993) lists the following advantages and disadvantages for extended detention ponds:

ADVANTAGES

- Can provide peak flow control
- Possible to provide good particulate removal
- Can serve large developments
- Requires less capital cost and land area when compared to wet pond
- Does not generally release warm or anoxic water downstream

DISADVANTAGES

- Removal rates for soluble pollutants are quite low
- Not economical for drainage area less than 10 acres
- If not maintained, can be an eyesore, breed mosquitoes, and create undesirable odors

ADVANTAGES (cont.)

- Provides excellent protection for downstream channel erosion
- Can create valuable wetland and meadow habitat when properly landscaped

DESIGN CRITERIA

For adequate pollutant removal a minimum of 24 hours of extended detention must be provided for the design storm. Adjustments should be made in the outlet control device so that smaller runoff events are detained for at least six hours in the pond. Longer detention periods may be needed for streambank erosion control. And as a final check, the release rates should be evaluated to determine if they are erosive. The basin should be designed with a drawdown time of 24 to 40 hours.

A two stage design is recommended. The upper stage will be dry except during larger storm events, and the lower stage sized to be regularly inundated. The lower volume will be the site of the bulk of the pollutant removal, and will handle about 50-90% of the storms. A stone lined pilot channel should be constructed from the inlet to the lower stage. In general the basin should be wedge shaped with the inlet at the narrow end of the basin. The shape of the basin should have a length to width ratio of 3 or more. Dead storage areas should be avoided to allow for full utilization of the basin.

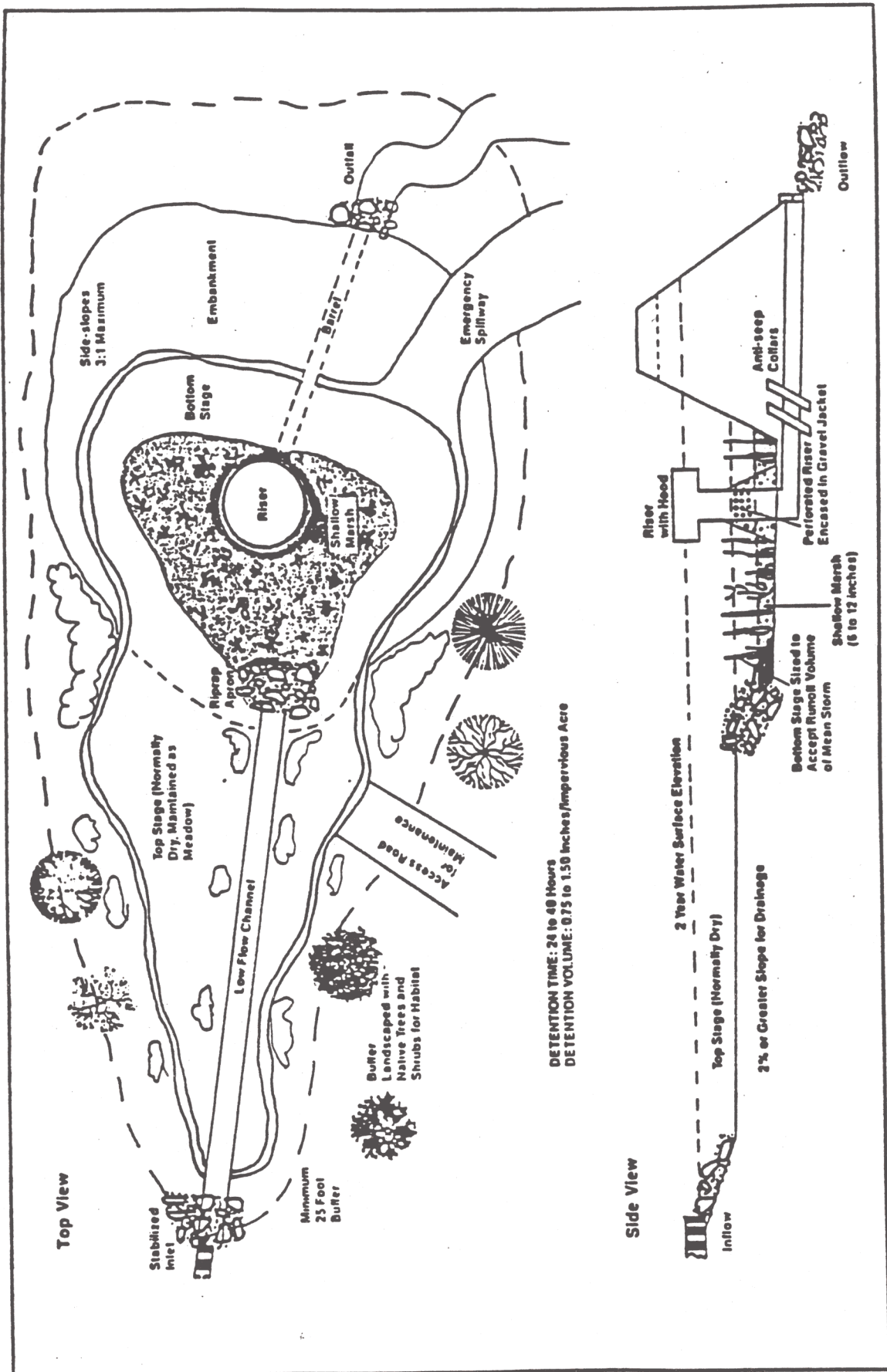
If a shallow marsh is to be utilized in the basin the depth should be not less than 6 inches and not more than 24 inches. The average depth of the temporary storage area should normally not exceed 10 feet. A shallow basin with a large surface area is preferable to a deeper one with a smaller surface area.

Side slopes of the extended detention pond should be no steeper than 3:1 (h:v) and no flatter than 20:1. Access and safety should be considered in determining proper basin side slopes.

A buffer of dense vegetation or fencing should be provided to limit access.

Pond berm may be classified as a dam and require approval by the Water Resources Division of DES

Figure 5.1: Schematic of Extended Detention Basin With Marsh (USDA-NRCS, 1992)



MAINTENANCE REQUIREMENTS

The embankment should be inspected annually to determine if rodent burrows, wet areas, or erosion of the fill are present. Trees and shrubs should be kept off the embankment and emergency spillway areas.

The vegetation should be mowed once per year to discourage woody growth. As much as possible vegetation should be managed without the aid of fertilizers.

Pipe inlets and outlets should be inspected annually and after major storm events.

Sediment should be continually checked in the basin and removed as necessary.

The structure should be inspected by a qualified professional on a periodic basis.

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